PCT/GB 2004 / 0 0 4 9 4 9

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

RECD 17 JAN 2005
WIPO PCT

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed Stephen Hordley

Dated 6 January 2005

BEST AVAILABLE COPY

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
DL
10 SEP 2004
RECEIVED BY FAX

The Patent Office

13SEP04 E925164-1 000790
P01/7700 0.00-0420132.3 ACCOUNT CHA

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference	PA 5262	
2. Patent application number *(The Patent Office will fill this part in)*	0420132.3	10 SEP 2004
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	PetroTechnik Limited PetroTechnik House Olympus Close Whitehouse Industrial Estate IPSWICH, Suffolk IP1 5LN	
Patents ADP number *(if you know it)*		
If the applicant is a corporate body, give the country/state of its incorporation	GB 7323132003	
4. Title of the invention	Connection between a Pipe and a Wall	
5. Name of your agent *(if you have one)*	MARKS & CLERK	
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	45 Grosvenor Road St Albans Hertfordshire AL1 3AW	
Patents ADP number *(if you know it)*	~~1511001~~ 8885728001	

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute *(see note f)*

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — Yes

Answer YES if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO (See note d)

0116628 10-Sep-04 06:30

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	19
Claim(s)	-
Abstract	-
Drawing(s)	6 only

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	-
Request for a preliminary examination and search (Patents Form 9/77)	-
Request for a substantive examination (Patents Form 10/77)	-
Any other documents (please specify)	-

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Marks & Clerk /IHC

Date 10 Sept. 2004

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Ian Harold COATES

01727 854215

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered YES in part 8, a Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

CONNECTION BETWEEN A PIPE AND A WALL

Field of the Invention

This invention relates to fittings for providing a seal between a wall and a pipe passing through an opening in the wall, to a method of providing such a seal, and to an assembly comprising the combination of a pipe, a wall and a fitting providing a seal between the two. The invention is particularly applicable to the provision of a seal between a pipe and a wall of a manhole chamber as found in a subterranean fuel tank or between a pipe and the wall of sump for a dispensing pump, for example in a petroleum forecourt installation, and in particular where the wall of a chamber or sump is made of glass reinforced plastic (GRP).

Background to the Invention

Subterranean piping systems of the type that are typically installed at service stations are generally utilized to communicate fuel or chemicals between an underground storage tank and an above ground dispensing station. The underground storage tanks and associated piping pose serious potential environmental and fire hazards as the chemicals contained therein could and have in the past leaked into the earth.

Oil companies have been under considerable pressure to ensure that environmental concerns are given priority in the planning and installation of petrol station infrastructures. This has not been without significant on-cost. One important advancement has been the use of pipeline systems constructed from plastics materials which have enabled the oil companies to install cost-effective environmentally acceptable alternatives to steel pipework systems which tend to corrode over time.

Moreover, over recent years there have been major developments in fuel technology which have culminated in commercially available alternative fuels containing additives which have replaced lead-based antiknock compounds. Research also continues to centre on reducing sulphur content and hazardous emissions from fuel. In order to eliminate lead and sulphur from fuels, exotic additives and octane enhancers such as MTBE (methyl tertiary butyl ether) have been developed which are based on complex organic or heavy metal organic additives.

The presence of these additives in fuel can give rise to major environmental issues. Some such issues are described in an article entitled "MBTE – How should

Europe Respond", in Petroleum Review February 2000 pages 37-38. The entire text of this article is incorporated herein by reference by way of background information. The authors conclude that lead and some other metals are the most effective octane enhancers. However, lead is in the final stages of being phased out because of environmental and health issues, and the most readily available alternative, MMT (methylcyclopentadienyl manganese tricarbonile) is currently not widely accepted. The only other octane enhancers currently available are MTBE and other ethers such as ethyl tertiary butyl ether (ETBE) and tertiary amyl methyl ether (TAME), or alcohols such as ethanol. The ethers all tend to have similar properties and drawbacks. Ethanol is already used as a gasoline-blending component in parts of the United States where it is readily available, and in Brazil. It is an effective octane booster but has a number of drawbacks: it needs a "water-free" distribution system and is not without ground water issues. It is currently not recommended by the motor industry and is not cost-competitive.

The introduction of new fuel mixtures and esoteric additives has led oil companies to question whether existing pipeline systems can cope with the new fuels with regards to mechanical performance and permeability resistance. In some instances this will result in the pipework having to be replaced by pipework made from a more resistant material, with all the disruption that entails.

In petroleum forecourt installations, pipework running between dispensing pumps and a subterranean fuel storage tank passes into a manhole chamber which is situated directly above the manhole lid of the tank. The chamber is normally defined by an upstanding wall which, when viewed from above, can be of an octagonal, square, circular or rectangular shape, and which includes apertures through which respective pipes pass.

To overcome environmental concerns this pipework is now generally constructed from plastics materials and many current designs of forecourt installation utilise secondary containment. This involves containing each fuel supply pipeline in a respective secondary containment pipeline which is optionally sealed at its ends to the fuel supply pipeline. The secondary containment pipeline prevents leaks from the fuel supply pipeline from being discharged into the environment, and also can convey leaked petrol to a remote-sensing device. Typically, the pipes forming the secondary containment pipeline are initially separate from the fuel pipes and are sleeved over the latter as the fuel pipes are installed between the fuel storage tanks and dispensing pumps.

A common material for the chamber to be constructed from is glass-reinforced plastic which involves moulding a resin or other polymeric material reinforced with fibres such as glass fibres.

It is desirable to provide a seal between each of the apertures in the chamber wall and its respective pipe to avoid ingress of water into the manhole chamber and egress of fuel from the manhole chamber. To that end, it is known to attach a fitting to a portion of the wall around the aperture and a rubber "boot" that sleeves over the pipe and is clamped to both the pipe and the fitting by, for example, jubilee (TM) clips. Some types of such fitting are bolted to the chamber wall, whilst other types of fitting provide inner and outer parts between which the wall is sandwiched, the inner and outer parts being held together by a screw-threaded connector which extends through the aperture. These connectors often incorporate a rubber seal located between a part of the connector and the chamber wall.

Neither type of fitting provides a completely effective seal.

Over time, both types of seal can allow water to leak into the manhole chamber and to accumulate in a pool in the bottom of the chamber. This in turn makes the maintenance of the chamber bottom and tank entrance extremely difficult. In addition a defective seal can allow any petroleum fluid or vapours which find their way into the chamber to escape into the environment.

It would be preferable if such a fitting could be chemically bonded or electrofusion welded both to the pipe and to the chamber wall. One type of such fittings, manufactured from a plastics material capable of electrofusion to both the pipe and the chamber wall is known from GB2332255 (PetroTechnik Ltd). However, increasingly strict legislation requires the seals to be monitored more and more effectively and there is a need to ensure the integrity of the seals between the fitting, pipe and wall and preferably to also monitor the seal.

The problems of forming a seal between pipework and a chamber wall are compounded if the chamber is of a double-walled construction, since a seal must then be formed between the pipe and both the inner and the outer wall.

Accordingly it is an object of the present invention to provide a fitting for forming a seal between pipework formed from a plastics materials and a chamber which overcomes some or all of the above disadvantages.

Summary of the Invention

According to a first aspect of the present invention there is provided a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall

and a secondarily contained pipe assembly comprising a primary, supply pipe contained within a secondary pipe, said pipe assembly passing through said opening, said fitting comprising:-

(i) a first portion adapted to form a tight sliding fit with said secondary pipe, said first portion incorporating heating windings;

(ii) a second portion adapted to accommodate one or more radially extending flanges, said flange(s) being adapted to engage with the chamber wall around substantially the entire circumference of the flange;

(iii) a third portion adapted in a first region to form a tight sliding fit with said secondary pipe and in a second region adapted to form a tight sliding fit with a primary pipe, said first and second regions incorporating heating windings.

Whilst the fitting described in the embodiment above provides heating elements adapted to form an electrofusion weld to the primary pipe, as well as to the secondary pipe, it will be appreciated that the heating elements serving to form a seal with the primary pipe can be omitted, and replaced by a conventional rubber boot. Such sealing boots are well known and typically provide a valve for monitoring the integrity of the interstitial space between the primary and secondary pipes.

Preferably the flanges are secured to the second portion by securing means.

Preferably the second portion accommodates two flanges.

In an alternative embodiment, one of the flanges can be an integral part of the second portion and the second flange, if present, is secured to the second portion by a securing means.

More preferably the securing means comprises of complementary screw threaded regions on an outer surface of the second portion and an internal diameter of said flange(s).

Preferably two flanges are used which clamp, in use, on either side of the chamber wall.

In a particularly preferred embodiment the chamber is a double walled chamber.

More particularly the chamber maintains an interstitial space between the walls.

Preferably the first and third portions are formed from an electrofusible plastics material.

In a particularly preferred embodiment the heating windings are incorporated in the inner surface of the first and third portions. It is thus possible to electrofuse

the first and third portions to the pipe assembly passing through the fitting in use to form a fluid-tight seal between the fitting and the secondarily contained pipe.

Preferably the second portion is formed from a different material from the first and third portions with a substantially fluid-tight joint there between. In this way, the second portion can be formed from a material that forms a tight seal with the flange(s) whilst the first and third portions can be formed from a plastics material which is electrofusible to the pipe. The flange(s) can be formed from a material that bonds readily to the chamber wall. Such suitable flange materials include metals such as stainless steel, coated steel, aluminium, coated aluminium, GRP, a plastics material or a polymer resistant to fuel. A resin or other adhesive can be used on the face of one or both flange(s) in order to obtain a long-lasting waterproof seal between the flange(s) and the chamber wall(s).

Preferably if there is more than one flange they are formed from substantially the same material.

In a preferred embodiment the integrity of the seal may be tested by monitoring the space formed between the inner surface of the second portion and the outer surface of the secondary pipe.

In a particularly preferred embodiment the integrity of the seal may be monitored via the interstitial gap of a secondarily contained wall, an aperture through the body of the second portion being provided for this purpose.

More preferably the integrity of the seal is monitored by connecting the space formed between the inner surface of the second portion and the outer surface of the secondary pipe and the interstitial gap via a passage.

In an alternative embodiment the space formed between the inner surface of the second portion and the outer surface of the secondary pipe is monitored via a test point valve.

It will be appreciated that the present invention also extends to encompass underground pipework systems including such fittings, and to garage forecourt systems incorporating them, methods for manufacturing such fittings and methods of forming a fluid-tight seal using such fittings.

Brief Description of the Drawings

Embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings wherein:-

Figure 1 is a partially cut-away side view of part of a petroleum forecourt installation which includes a tank having a manhole chamber, having a fitting in accordance with the invention;

Figure 2 illustrates a cross-section through a fitting according to one embodiment of the invention;

Figure 3 illustrates an exploded cross-section of the three portions of the filling of Figure 2;

Figure 4 illustrates an elevation view of a flange;

Figure 5 illustrates a cross-section through a fitting according to a further embodiment; and

Figure 6 illustrates a cross-section through a fitting according to yet another embodiment.

The dimensions provided in Figures 5 and 6 are by way of example only. Those skilled in the art will appreciate that the embodiments described herein may be made in a variety of shapes and sizes.

Description of the Preferred Embodiments

The present embodiments represent currently the best ways known to the applicant of putting the invention into practice. But they are not the only ways in which this can be achieved. They are illustrated, and they will now be described, by way of example only. By way of terminology used in this document the following definitions apply:-

chamber – any receptacle designed to keep a fluid in or out. This includes, but is not limited to, manhole and sump chambers as described herein. It also includes tanks in general.

energy transfer means – a generic term describing any form of energy source. Typically it takes the form of a resistance winding which heats up when an electrical current is passed through it. The term also encompasses other welding techniques including ultrasonic welding and induction welding.

flange – any collar suitable for attaching a fitting to a chamber wall. In the examples given the surface of the flange which contacts the chamber wall is substantially planar. However, it will be understood that the flange must conform to the profile of

the chamber wall around the pipe inlet opening. Thus the flange can adopt any suitable conformation to achieve the necessary contact with a flat or curved surface or even the corner of a container wall.

fluid – whilst the examples provided relate mainly to liquids, the term fluid refers to liquids, vapours and gases. For example, should a leak occur in a secondarily contained pipe in a garage forecourt installation then petrol or petrol vapour will collect in the manhole chamber. It is essential that this petrol vapour cannot escape through the wall of the chamber and into the surrounding ground.

pipe – the examples given herein are for a generally circular cross-sectioned single wall pipe. However, the invention also covers other cross-sections such as box sections, corrugated and the like and secondarily contained pipes of the "pipe-within-a-pipe" type. In this case the sealing member or boot for sealing the sleeve to the pipe will be rather more complex. However, such boots are well known in the art. The invention also encompasses pipes which are not circular in cross-section.

tubular sleeve - this term has a very broad meaning. It includes any tubular structure through which a pipe may pass. Although illustrated and described as substantially circular cylindrical in form, a sleeve according to this invention need not have a substantially circular cross-section and may confirm to the profile of the pipe to be accommodated in it. Nor need the cross-section of the sleeve be uniform along its whole length, i.e. it need not be cylindrical.

Glass reinforced plastic (GRP) – The term GRP has a very broad meaning in this context. It is intended to encompass any fibre-reinforced plastic wherein a fibre of any type is used to strengthen a thermosetting resin or other plastics material.

The petroleum forecourt installation shown in Figure 1 comprises a pair of dispensing pumps 1 and 2 connected to a subterranean tank 3 through a pipeline 4. The pipeline 4 is formed from contiguously arranged sections of polyethylene pipe. The pipeline 4 extends from the pumps 1 and 2 into a manhole chamber 6 immediately above the tank 3. The chamber 6 is defined by a GRP member 8 having a sidewall 10 and a base 12.

Figure 1 shows two lines extending from the pipeline 4 into the tank 3. These lines relate to two alternative forms of fuel supply system and are both shown for the sake of completeness. In practice, only one of the lines would extend from the pipeline 4 into the manhole chamber 6. One of those lines is a suction line 14 which is used where the dispensing pumps 1 and 2 are fitted with suction pumps. The alternative line, reference 16, is a pressure line connected to the pipeline 4 via a pump 18 which is operable to propel fuel from the tank 3 to the pumps 1 and 2.

It can be seen from Figure 1 that the wall 10 has to be apertured in order to allow the pipeline 4 to pass into the chamber 6. In order to prevent water leaking from the surrounding ground (here denoted by reference numeral 20) into the chamber 6 through the aperture, the pipe is sealed to the cylindrical wall 10 by means of a fitting 22 shown in more detail in Figures 2 to 3 inclusive. In the event of a spillage or a leak in a supply pipe the seal also prevents fuel from escaping into the environment.

Figure 2 illustrates the fitting 22 in greater detail. The purpose of this fitting is to form a strong, permanent, fluid-tight seal between the fitting and the chamber wall and between the fitting and the pipework system.

In this embodiment, fitting 22 comprises three portions, a first portion 30, a second portion 31 and a third portion 32.

Turning first to portion 30, a first end 33, has an internal diameter which is a tight sliding fit over the outside of the secondary pipe 34. Portion 30 is thus generally cylindrical in shape with non-uniform cross-section having a longitudinal axis through which a secondary pipe may pass through the entire body of the portion.

In this particular embodiment, the first portion 30 and the third portion 32 are formed from plastics material, such that the inner surface of those portions, at least, is electrofuseable to the outer surface of the primary and secondary pipe, to form a substantially fluid-tight seal there between. The inner surface 36 of the portion 30 accommodates energy transfer means, in this case windings 37 of electrical heating wire which lie close to, or at, the internal surface of the portion 30. These windings are electrically connected to terminal pins 38,39 projecting from the plastics portion 30. The terminal pins 38,39 can be shrouded by hollow cylindrical plastic terminal shrouds 40,41 projecting from, and integral with, the portion 30. The methodology for laying heating wires of this type on the inner surface of a plastics fitting is well known.

The first portion of the fitting is joined in a substantially fluid type manner during manufacture to the second portion 31. Portion 31 is generally manufactured of metal but can be manufactured from any material strong enough to hold a screw thread and engage a complementary screw threaded article. In this example the second portion 31 is made of metal and is crimped or externally swaged 43 onto the first portion. An outwardly extending flange or hook 42 engages with a shoulder or step 58 on the first portion 30 to prevent lateral or axial movement of the first portion 30 once the joint between them has been made and provides greater strength and

stability once the two components are joined together. The second portion 31 can be slotted radially or longitudinally to resist any movement of the plastic component 12. In order to improve the fluid-tight nature of the seal between these two components, a series of grooves, slots or ridges (not shown) can be formed in the region where the two sleeves overlap. When the joint is formed, plastics material fills these grooves, preventing the two components from separating in use.

Optionally, the seal between the two sleeves can be further improved by incorporating a sealing means such as an O-ring (not shown). The O-ring nests into a annular channel around the circumference of one or other of the portions. It will be appreciated that the O-ring seal can be positioned during assembly on either the first or second portion. For ease of construction it would normally be positioned on the outer surface of the first portion, towards the end of that portion which is located within the body of the fitting itself.

It will be appreciated that the O-ring could also be positioned in the end face of the first portion, engaging with a shoulder in the second portion.

Because the O-ring is internal to the fitting, and sealed within, it is expected to have a very long life, at least the life of the fitting.

The second portion 31 has an internal diameter which can accommodate the secondary pipe 34, either leaving a space 44 or, as an alternative embodiment, as a tight sliding fit over the outside of the secondary pipe 34. In either case some form of space will exist between the inner surface of the second portion 31 and the outside of the secondary pipe, even if this space is not visible to the eye.

The outer surface 45 of the second portion is adapted to accommodate one or more radially extending flanges 46,47 by means of a screw threaded region 48,49. The internal diameter of the flange(s) are adapted to comprise a complementary screw threaded region. In an alternative embodiment one of the flanges 46,47 could be an integral part of portion 31.

The flanges 46,47 are adapted to conform to and engage with the surface of the chamber wall. Thus the flange(s) may be flat if the sides of the chamber are flat or curved if the chamber has curved walls.

The diameter, size, shape, depth and pitch of threads of this component are designed to allow the flange(s) to thread onto and over the corresponding end of the second portion.

A typical example of the flange(s) 46,47 can be seen in more detail in Figure 4. The face of the flange is perforated by a series of apertures. Apertures or indentations 70, 72 are provided in the face of the flange in order to engage the

flange with a tool during assembly to turn it and tighten it against the chamber wall. Cut outs or slots 71 can be provided to allow resin to pass through the body of the flange in use to increase the strength of bond between the flange and the wall (see below).

Various other shapes and devices can be used to provide a turning purchase on the flanges. Opposing sides of one or both portions could contain flats such that a spanner, wrench or special tool could be used. Alternatively the flange could incorporate handles, protrusions or cut outs which could be used to obtain the necessary purchase.

The flange is shown as having a uniform cross-section. However, in order to extend the screw-threaded region on the flange, the flange could incorporate a collar (not shown) extending around the central aperture in the flange and extending longitudinally along the fitting. Substantially the entire inner surface of said collar may then be screw threaded.

One of the flanges, but not both, may be formed as an integral part of the second portion 31. This provides for increased strength in the fitting but does mean that the fitting may only pass through the aperture in the chamber wall in one direction.

The second portion 31 is also joined in substantially a fluid-tight manner during manufacture to the third portion 32. Again, in this example the second portion is crimped or externally swaged over the third portion which is held in place between shoulder 42' and crimp 43'. The join between the second and third portions is essentially the same as the join between the first and second portions described above.

The third portion 32 comprises a first region 50 adapted to form a tight sliding fit with the secondary pipe 34. The secondary pipe pay pass along the third portion from one end only and only up to a certain point, where its passage is halted by a reduction in the internal diameter of that portion. The inner surface 51 of the portion 32 accommodates energy transfer means, in this case windings 52 of electrical heating wire which lie close to, or at, the internal surface of the first region 50 of the third portion 32. These windings are electrically connected to terminal pins 53,54 projecting from the plastics portion 32, in series with a second set of windings (see below).

The third portion 32 further comprises a second region 55 adapted to form a tight sliding fit with the primary pipe 35. The inner surface 56 of the second region 55 of the third portion 32 accommodates energy transfer means, in this case

windings 57 of electrical heating wire which lie close to, or at, the internal surface of the second region 55 of the third portion 32. These windings are also electrically connected to terminal pins 53,54 projecting from the plastics portion 32. Thus when the terminal pins 53,54 are activated both energy transfer means 52 and 57 will be activated and will fuse to both the primary 35 and secondary 34 pipe.

In an alternative embodiment windings 52 and 57 could be connected to separate pairs of terminal pins. This arrangement would allow electrofusion welds to the secondary and primary pipes to be formed in separate operations.

The threaded regions 48,49 act as a securing means to secure the flanges 46,47 onto the second portion and to clamp them in use firmly on either side of the chamber wall. A variety of securing means can be used such as bolts or other clamping means.

In use, a first flange 46 is slid over the secondary pipe 34, assuming this is already in place. The fitting comprising the first 30, second 31 and third 32 portions is then passed through a pre-drilled hole in the chamber wall, usually from the inside of the chamber. The flange 46 is the slid back over the first portion and screwed onto the threaded region 49 of the second portion which extends through the chamber wall, until the flange engages flat against the chamber wall.

Before doing this however, GRP resin, glass fibre mat or other adhesive is applied to the face of the flange or to the chamber wall around the aperture. Similar adhesive is applied to the flange/chamber wall on the outside of the chamber. Alternatively the flange(s) may be clamped firmly against the chamber wall and resin or other suitable adhesive applied over substantially the whole exposed surface of the flange and the surrounding area. This will also result in a strong fluid-tight seal.

In a further alternative resin/adhesive may be applied to both faces of the flange, both between the flange and the chamber wall and over the external, exposed face of the flange.

The second flange 47 is then screwed onto the threaded region 48 of the second portion, and the two flanges are tightened onto the chamber walls to form a fluid-tight seal once the adhesive has set.

A primary and secondary pipe are then passed through the fitting as shown in Figure 2 and an electric current passed through windings 37, 52 and 57 to seal both primary and secondary pipes to the fitting.

It will be readily appreciated that the plastics part of this type of fitting can be formed from a wide variety of plastics materials as selected by the materials

specialist. Preferably the plastic component is formed from one or more plastics materials selected from the group comprising:-

polyethylene;
polypropylene;
polyvinyl chloride;
polybutylene
polyurethanes;
polyamides, including polyamides 6, 6.6, 6.10, 6.12, 11 and 12;
polyethylene terphthalate;
polybutylene terephthalate;
polyphenylene sulphide;
polyoxymethylene (acetal);
ethylene/vinyl alcohol copolymers;
polyvinylidene fluoride (PVDF) and copolymers;
polyvinyl fluoride (PVF);
tetrafluoroethylene-ethylene copolymer (ETFE);
tetrafluoroethylene-hexafluroethylene copolymers (FEP)
ethylene tetrafluoroethylene hexafluropropylene terpolymers (EFEP)
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride (THV);
polyhexafluoropropylene;
polytetrafluoroethylene (PTFE);
polychlorotrifluoroethylene;
polychlorotrifluoroethylene (PCTFE);
fluorinated polyethylene;
fluorinated polypropylene;

and blends and co-polymers thereof.

This selection is not intended to be limiting but rather demonstrates the flexibility and breadth of the invention. The plastics material which is most compatible to the pipe to which it will be joined and with the lowest permeability to the fluid in question will usually be chosen by the materials specialist. Furthermore, it is known to use blends of two or more polymers and this invention extends to cover known and yet to be developed blends of plastics material.

Alternatively the plastic component can be formed from 2 or more layers including but not limited to a barrier layer or layers. This form of construction may require the use of one or more tie or adhesive layer between adjacent layers.

Alternatively direct bonding may be used to adhere the individual layers, preferably during melt processing, whereby one or both of the materials have been chemically modified to bond to the other. Additionally, the plastics material or barrier layer(s) may incorporate a dispersed electrically conductive material producing a maximum surface resistivity of 10^6 Ω/sq. This avoids build up of potentially dangerous static electrical charges. A surface resistivity in the range of 10^2 to10^6 Ω/sq is preferred, with a more preferred surface resistivity in the range 10^2 to10^5 Ω/sq Examples of possible barrier layers include:

polyvinylidene fluoride (PVDF) and copolymers;
polyvinyl fluoride (PVF);
tetrafluoroethylene-ethylene copolymer (ETFE);
tetrafluoroethylene-hexafluroethylene copolymers (FEP)
ethylene tetrafluoroethylene hexafluropropylene terpolymers (EFEP)
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride (THV);
polyhexafluoropropylene;
polytetrafluoroethylene (PTFE);
polychlorotrifluoroethylene;
polychlorotrifluoroethylene (PCTFE);
fluorinated polyethylene;
fluorinated polypropylene,

and blends and co-polymers thereof.

Once again, this selection is not intended to be limiting, but rather demonstrates the wide range of polymers that may be used for this purpose. It is intended that this disclosure encompasses all known fluoropolymers providing a suitable barrier function, and those yet to be discovered.

Fittings according to the present invention can be used equally well on single or double walled chambers. Because a seal is formed on both sides of the wall, the integrity of the interstitial region between the chamber walls is maintained and can be monitored. They can be used equally well to form a seal between a pipe and the wall of a sump, such as sumps 68 and 69 in Figure 1.

It is possible to monitor the space 44 formed between the outer surface of the secondary pipe 34 and the inner surface of the second portion. If the wall of the containment chamber is secondarily contained a hole can be drilled in the second portion to connect the space 44 with the interstitial region of the wall of the

containment chamber. It is then possible to monitor the space 44 and thus the whole fitting at the same time as monitoring the interstitial region of the wall.

For the purposes of this description the term pipe generally refers to a circular cross-sectioned pipe. However, this invention also covers pipes having other cross-sections such as box sections, corrugated and the like and also single walled or secondarily contained pipes.

In a further embodiment as shown in Figure 5, the coupling between the primary pipe 135 and the wall 108 (e.g. the wall of a chamber or sump) comprises five principal components, namely a first coupling portion 130, a first intermediate member 140, a second coupling portion 150, a second intermediate member 160, and a third coupling portion 170. The first coupling portion 130, first intermediate member 140, second intermediate member 160 and third coupling portion 170 are made of one or more electrofusible plastics materials, examples of which have been provided above.

As shown in the figure, in this example the wall 108 comprises a double wall 110,112, with an interstitial space 114 therebetween.

Approaching the wall 108 from the left of the figure is a secondarily contained pipe assembly comprising a primary supply pipe 135 contained within a secondary pipe 134, with an interstitial space therebetween. The primary pipe 135 passes through an aperture in the wall 108 and extends towards the right of the figure. Additional pipework 136 is shown by way of an example of possible further pipework that may be connected to the primary pipe 135.

The first coupling portion 130 is configured such that the secondary pipe 134 passes into the first coupling 130, and is arranged such that the secondary pipe 134 extends approximately midway along the length of the first coupling 130. The first coupling 130 comprises a first portion 138 adapted to form a tight sliding fit around the external surface of the secondary pipe 134, and a second portion 139 adapted to couple to the first intermediate member 140. A ridge, protrusion or stop 133 (which may be annular) may be provided for the secondary pipe 134 to but against. This stop 133 determines the extent to which the secondary pipe 134 may inserted within the first coupling 130, and ensures that, when the secondary pipe 134 is fully inserted against the stop 133, it is sufficiently far in for a satisfactory coupling to be formed. The first coupling 130 further comprises energy transfer means (e.g. electrofusion windings (not shown)) in regions 138 and 139, electrically connected to terminals 131 and 132.

The third coupling portion 170 comprises a portion 174 adapted to provide a tight sliding fit around the exterior of the primary pipe 135. The internal diameter of the third coupling 170 widens to provide a second portion 176 adapted to couple to the second intermediate member 160. The third coupling 170 comprises energy transfer means (e.g. electrofusion windings (not shown)) in regions 174 and 176, electrically connected to terminals 171, 172.

The second coupling portion 150 is adapted to locate within the aperture provided in the wall 108, and to form a fluid-tight connection between the second coupling 150 and the wall 108. In a presently preferred embodiment this second coupling 150 is made of brass, although other metallic or plastics materials that are resistant to fuel and which may be bonded or joined to the wall material may alternatively be used.

The second coupling 150 comprises a first integral member 151,152,153,154,158 and a second, initially separate, flange or collar 157. The flange or collar 157 is preferably provided with a thread (or alternative attachment means) to enable it to be attached to a corresponding thread or attachment means provided on the first member 151,152,153,154,158, resulting in the configuration shown in the figure. The threads on the first member (adjacent region 153) are positioned such that, when installed, they are to one side of the wall 108 and do not interfere with the hole in the wall.

Optional O-rings 155,156 may be provided on the inner surface of region 158 and on the inner surface of the collar or flange 157, such that the O-rings form or enhance a fluid-tight seal with the external surfaces of the walls 110,112.

Additionally, a hole or aperture 159 may be provided through the second coupling 150, from a point between regions 151 and 152 to a point between region 158 and the collar 157, such that, when installed, the interstitial space 114 within the wall 108 is in fluid communication with a void 116 between the second coupling 150 and the exterior of the primary pipe 135.

The second coupling 150 is configured such that the first intermediate member 140 can locate between regions 151 and 153, and that the second intermediate member 160 can locate between regions 152 and 154. Either during manufacture of the second coupling 150, or during installation, the first intermediate member 140 is inserted between regions 151 and 153, and the second intermediate member 160 is inserted between regions 152 and 154, and regions 153 and 154 are swaged or otherwise deformed so as to grip the intermediate members 140 and 160.

During installation, the second coupling 150 (with the first and second intermediate members 140,160 attached) is inserted into the aperture in the wall 108, from the right side of the wall as shown in the figure, in a leftward direction, such that region 151 passes through the wall 108. (If used, O-ring 156 would be put in place in region 158 beforehand.) The second coupling 150 is manoeuvred until region 158 (and the O-ring 156) are adjacent the outer surface of wall 112. The collar or flange 157 (with O-ring 155 in place, if used) is then screwed into place over region 153, until it is flush against the outer surface of wall 110, in the configuration shown in the figure. GRP bonding, adhesives or other sealants 190,191 may then be applied around the flange 157 and region 158 of the second coupling 150, and around the second coupling 150 in general, overlapping the walls 110, 112, regions 157 and 158, and regions 153 and 154 onto the first and second intermediate members 140, 160, thereby obtaining a fluid-tight seal between the second coupling 150 and the wall 108.

The first coupling 130 is then located around the first intermediate member 140, such that the portion 139 of the first coupling makes a close fit with the intermediate member 140.

The primary pipe 135 is then introduced through the first coupling 130, and subsequently through the second coupling 150 and beyond. The secondary pipe 134 is introduced into the first coupling 130 as far as the stop 133.

From the right side of the figure, the third coupling 170 is then introduced such that region 176 locates around the second intermediate member 160, and region 174 forms a tight sliding fit around the primary pipe 135.

Additionally, the energy transfer means incorporated in the first coupling 130 and the third coupling 170 are energised by the connection of an electrical supply to terminals 131 and 132, and to terminals 171 and 172. This results in the formation of fluid-tight electrofused connections between region 138 of the first coupling 130 and the exterior of the secondary pipe 134, between region 139 of the first coupling 130 and the first intermediate member 140, between region 176 of the third coupling 170 and the second intermediate member 160, and between region 174 of the third coupling 170 and the exterior of the primary pipe 135.

Once the first, second and third couplings (130, 150, 170) and the first and second intermediate members (140, 160) are installed, void 116 beneath the secondary coupling 150 is in fluid communication with the interstitial space between the primary pipe 135 and the secondary pipe 134. If a hole or aperture 159 is provided between the interstitial space 114 in the wall and the void 116, then the

interstitial space 114 is consequently in fluid communication with the interstitial space between the primary pipe 135 and the secondary pipe 134.

Figure 6 illustrates another embodiment of a fitting comprising a first coupling portion 230, a second coupling portion 250 and a third coupling portion 270. The arrangement of the primary pipe 135, secondary pipe 134 and the wall 108 is the same as in Figure 5 described above.

The first coupling portion 230, second coupling portion 250 and third coupling portion 270 are made of one or more electrofusible plastics materials, examples of which have been provided above.

The first coupling portion 230 comprises regions 238 and 239, each of which incorporates energy transfer means such as an electrofusion winding (not illustrated), connected to electrical terminals 231 and 232. The internal surface of region 238 is configured to form a tight sliding fit with the exterior of the secondary pipe 134. As with the embodiment of Figure 5, a protrusion, ridge or stop 233 is provided for the secondary pipe 134 to but against.

The third coupling portion 270 comprises a first region 274 adapted to form a tight sliding fit with the exterior of the primary pipe 135, and a second region 276 adapted to couple with the second coupling portion 250. Regions 274 and 276 incorporate energy transfer means such as electrofusion windings (not shown), connected to electrical terminals 271 and 272.

The second coupling portion 250 here comprises a unitary article 251,252,258 made of electrofusible plastics material. In effect, this unitary article is equivalent to the first and second intermediate members (140, 160) in the embodiment of Figure 5, in combination with regions 151,152,153,154 and 158 of the second coupling portion 150 of Figure 5. However, in the present embodiment, by being formed of an electrofusible material the first and third coupling portions 230, 270 may be directly coupled to the second coupling 250 using electrofusion bonding, without the need for separate intermediate members (140 and 160 as described above) or swaging (e.g. of regions 153 and 154 described above).

A separate threaded flange or collar 257 is adapted to engage with corresponding threads provided on the outer surface 253 of the second coupling portion 250. The threads on surface 253 are positioned such that, when installed, they are to one side of the wall 108 and do not interfere with the hole in the wall. Optional O-rings 255,256 may be included as before. With reference to Figure 6, the mechanism by which the collar 257 attaches to the second coupling 250

involves introducing the collar 257 from the left in a rightward direction, such that the collar engages with the threads provided on surface 253 of the second coupling 250. The threads incorporated in the collar 257 and on the surface 253 may be moulded as an integral part of these components, or may be subsequently formed using a tapping technique that will be well-known to those skilled in the art. The thickness of the flange or collar 257 may be made greater than that shown in Figure 6, due to the limitations associated with manufacturing threaded plastic components.

A hole or aperture 259 may be provided through the second coupling portion 250, such that, once installed, the interstitial space 114 within the wall 108 is in fluid communication with a void 216 between the second coupling portion 250 and the exterior of the primary pipe 135.

During installation, the second coupling 250 is inserted into the aperture in the wall 108, from the right side of the wall as shown in Figure 6, in a leftward direction, such that region 251 passes through the wall 108. (If used, O-ring 256 would be put in place in region 258 beforehand.) The second coupling 250 is manoeuvred until region 258 (and the O-ring 256) are adjacent the outer surface of wall 112. The collar or flange 257 (with O-ring 255 in place, if used) is then screwed into place onto region 253, until the collar 257 is flush against the outer surface of wall 110, as shown in the figure. GRP bonding, adhesives or other sealants 290,291 may then be applied around the flange 257 and region 258 of the second coupling 250, and around the second coupling 250 in general, overlapping the walls 110, 112 and thereby obtaining a fluid-tight seal between the second coupling 250 and the wall 108.

The first coupling 230 is then brought into place, such that region 239 of the first coupling makes a close fit with region 251 of the second coupling 250.

The primary pipe 135 is then introduced through the first coupling 230, and subsequently through the second coupling 250 and beyond. The secondary pipe 134 is introduced into the first coupling 230 as far as the stop 233.

From the right side of the figure, the third coupling 270 is then introduced such that region 276 locates around region 252 of the second coupling 250, and region 274 forms a tight sliding fit around the primary pipe 135.

Finally, the energy transfer means incorporated in the first coupling 230 and the third coupling 270 are energised by the connection of an electrical supply to terminals 231 and 232, and to terminals 271 and 272. This results in the formation of fluid-tight electrofused connections between region 238 of the first coupling 230 and the exterior of the secondary pipe 134, between region 239 of the first coupling

230 and region 251 of the second coupling 250, between region 276 of the third coupling 270 and region 252 of the second coupling 250, and between region 274 of the third coupling 270 and the exterior of the primary pipe 135.

Once the first, second and third couplings (230, 250, 270) are installed, void 216 beneath the secondary coupling 250 is in fluid communication with the interstitial space between the primary pipe 135 and the secondary pipe 134. (Although not immediately apparent from Figure 6, a channel or recess is provided through region 251 of the second coupling 250, such that the void 216 is in fluid communication with the interstitial space between the primary pipe 135 and the secondary pipe 134.) If a hole or aperture 259 is provided between the interstitial space 114 in the wall and the void 216, then the interstitial space 114 is consequently in fluid communication with the interstitial space between the primary pipe 135 and the secondary pipe 134.

1/6

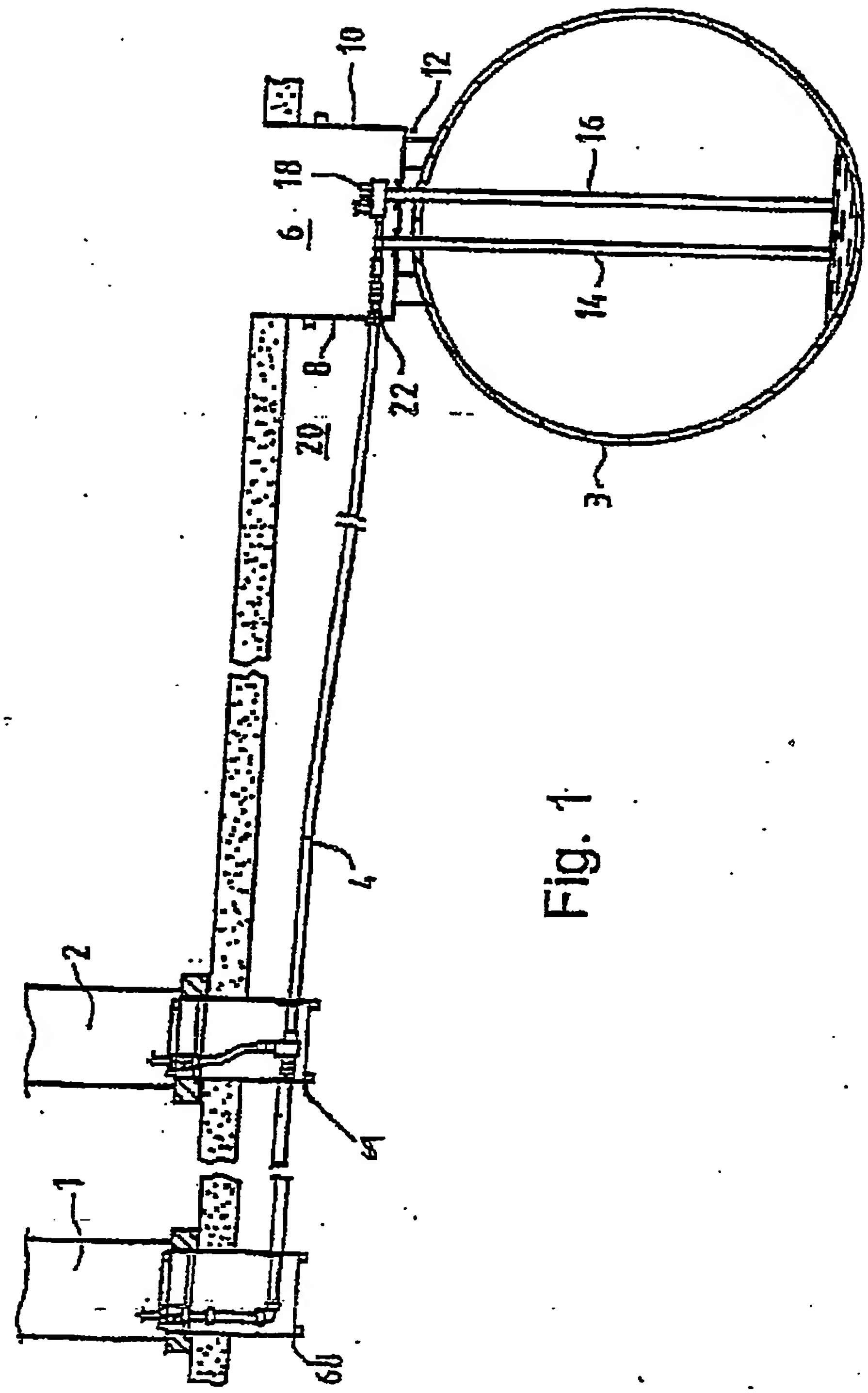


Fig. 1

2/6

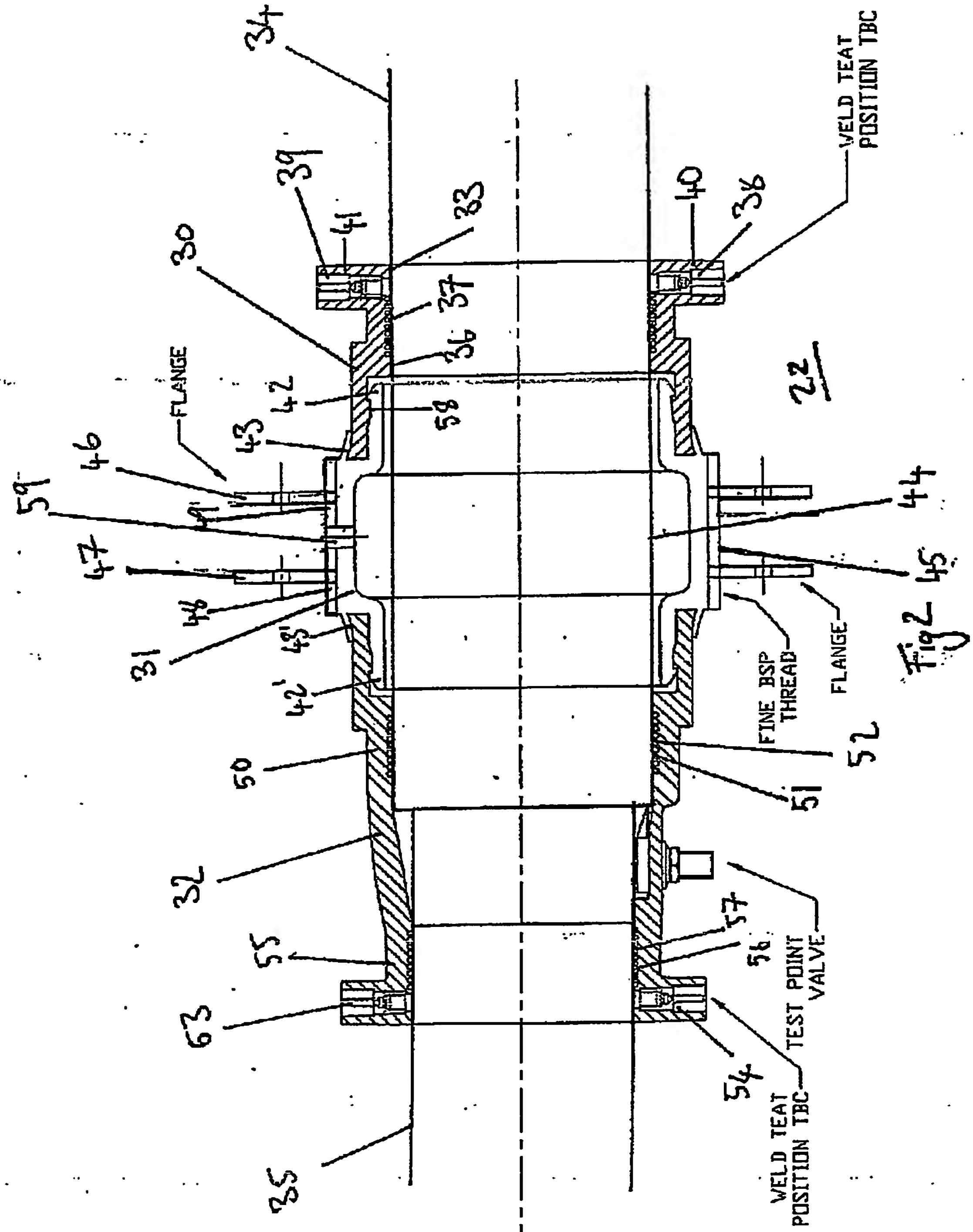

34
39
41
33
30
37
36
42
58
FLANGE
43
46
59
49
47
48
43'
31
42'
50
32
55
63
35
WELD TEAT POSITION TBC
40
38
22
44
45
FINE BSP THREAD
FLANGE
52
51
57
56
TEST POINT VALVE
54
WELD TEAT POSITION TBC

Fig 2

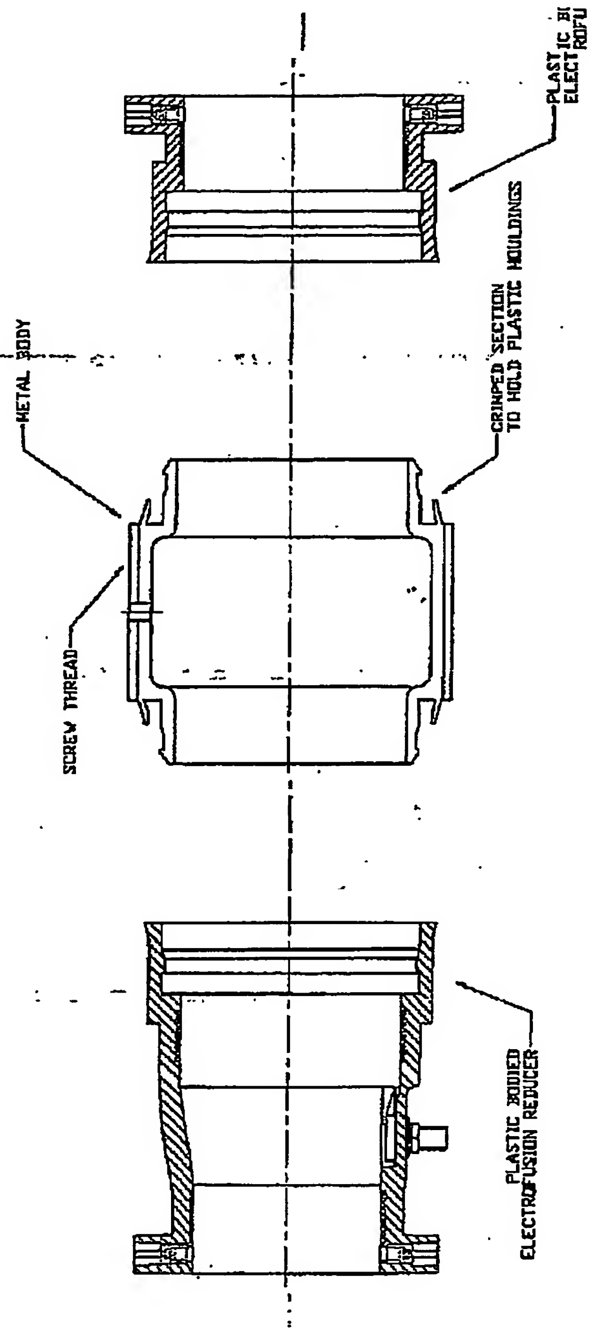

PLASTIC BI
ELECTROFU
METAL BODY
CRIMPED SECTION
TO HOLD PLASTIC MOULDINGS
SCREW THREAD
PLASTIC BODIED
ELECTROFUSION REDUCER

Fig 3

4/6

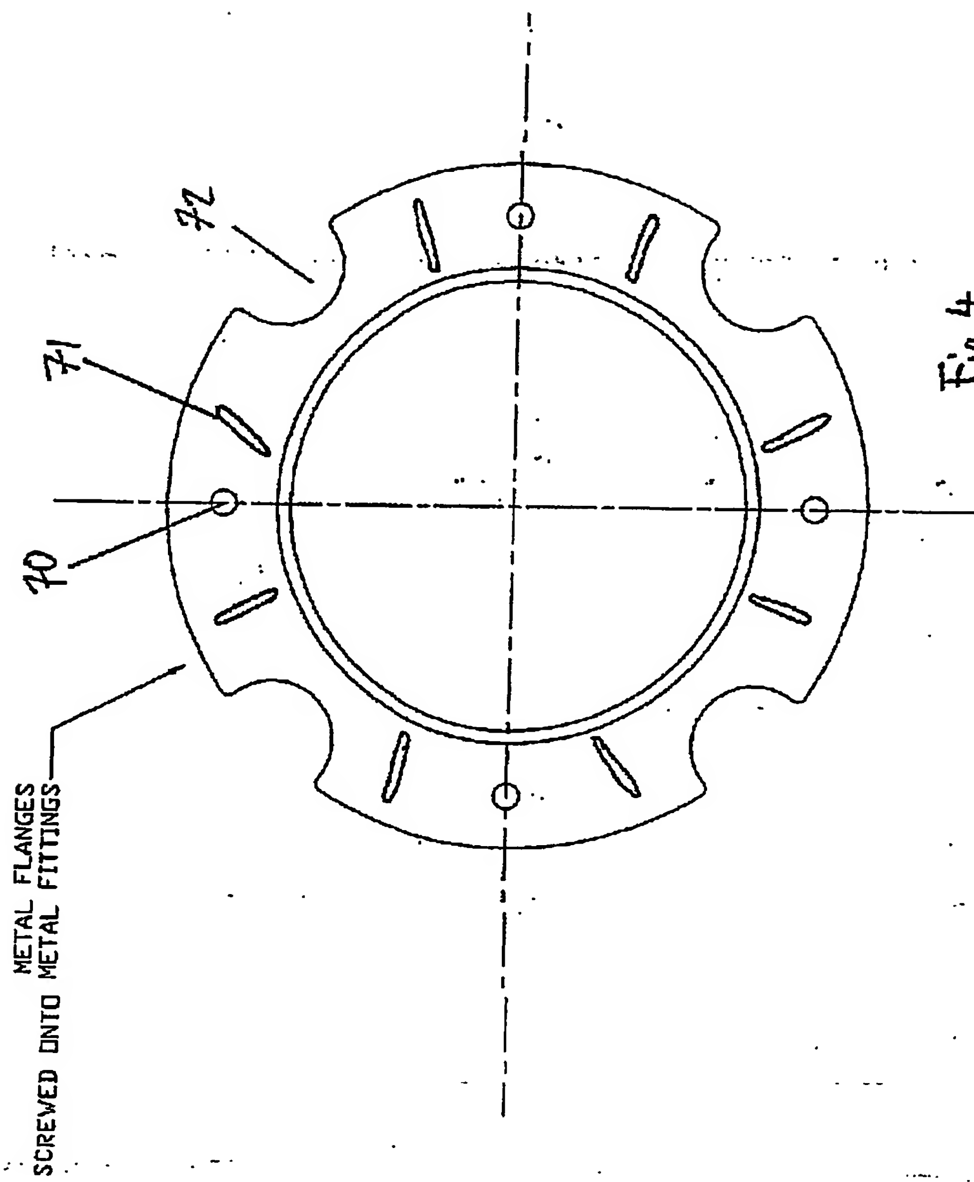
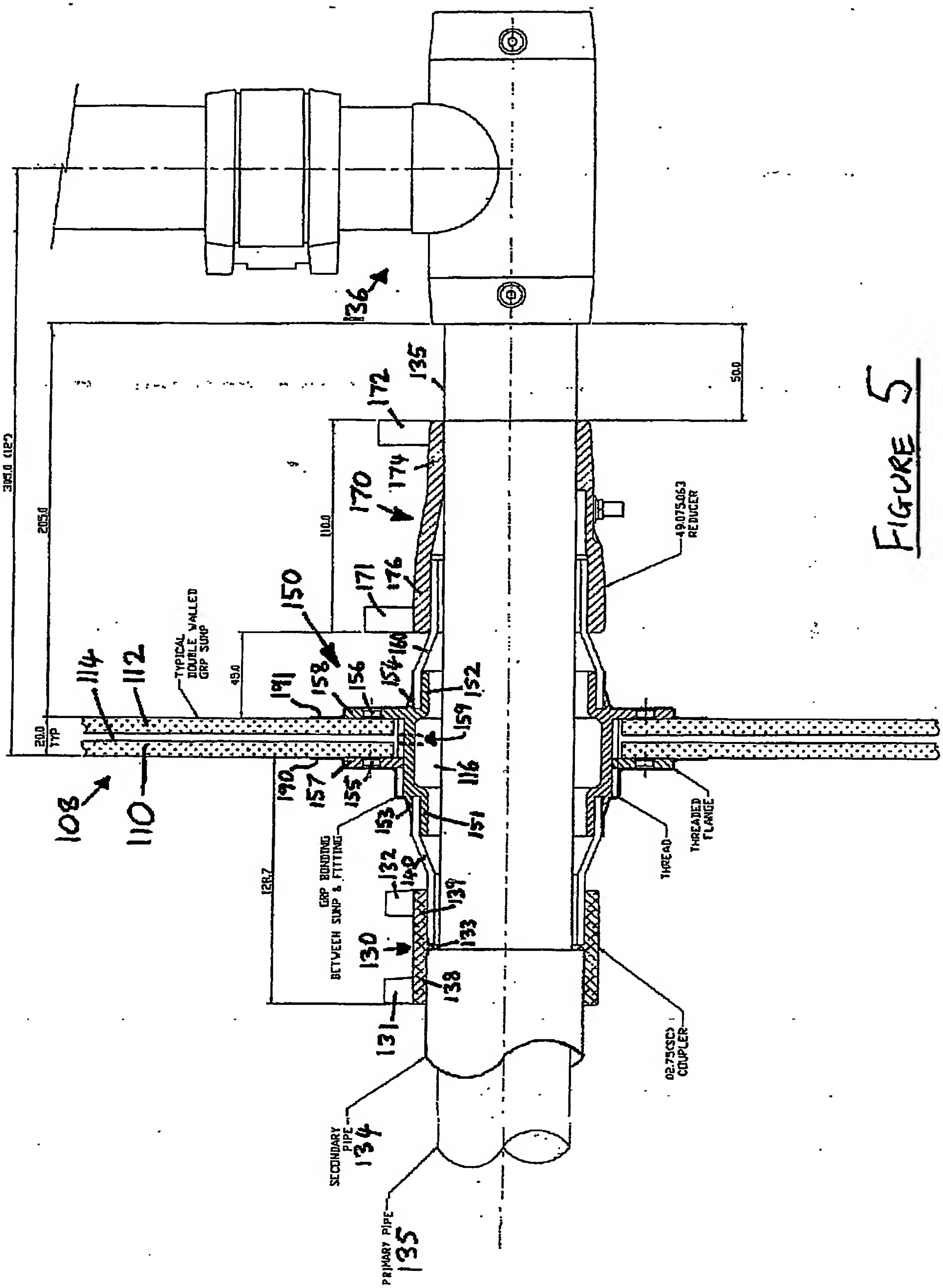


Fig 4

5/6



TYPICAL DOUBLE WALLED GRP SUMP
GRP BONDING BETWEEN SUMP & FITTING
SECONDARY PIPE
134
PRIMARY PIPE
135
THREAD
THREADED FLANGE
02.75(SC) COUPLER
49075063 REDUCER
305.0 (12")
205.0
110.0
49.0
20.0 TYP
128.7
50.0
108
110
112
114
116
130
131
132
133
135
136
138
139
140
150
151
152
153
154
155
156
157
158
159
160
170
171
172
174
176
190
191

FIGURE 5

6/6

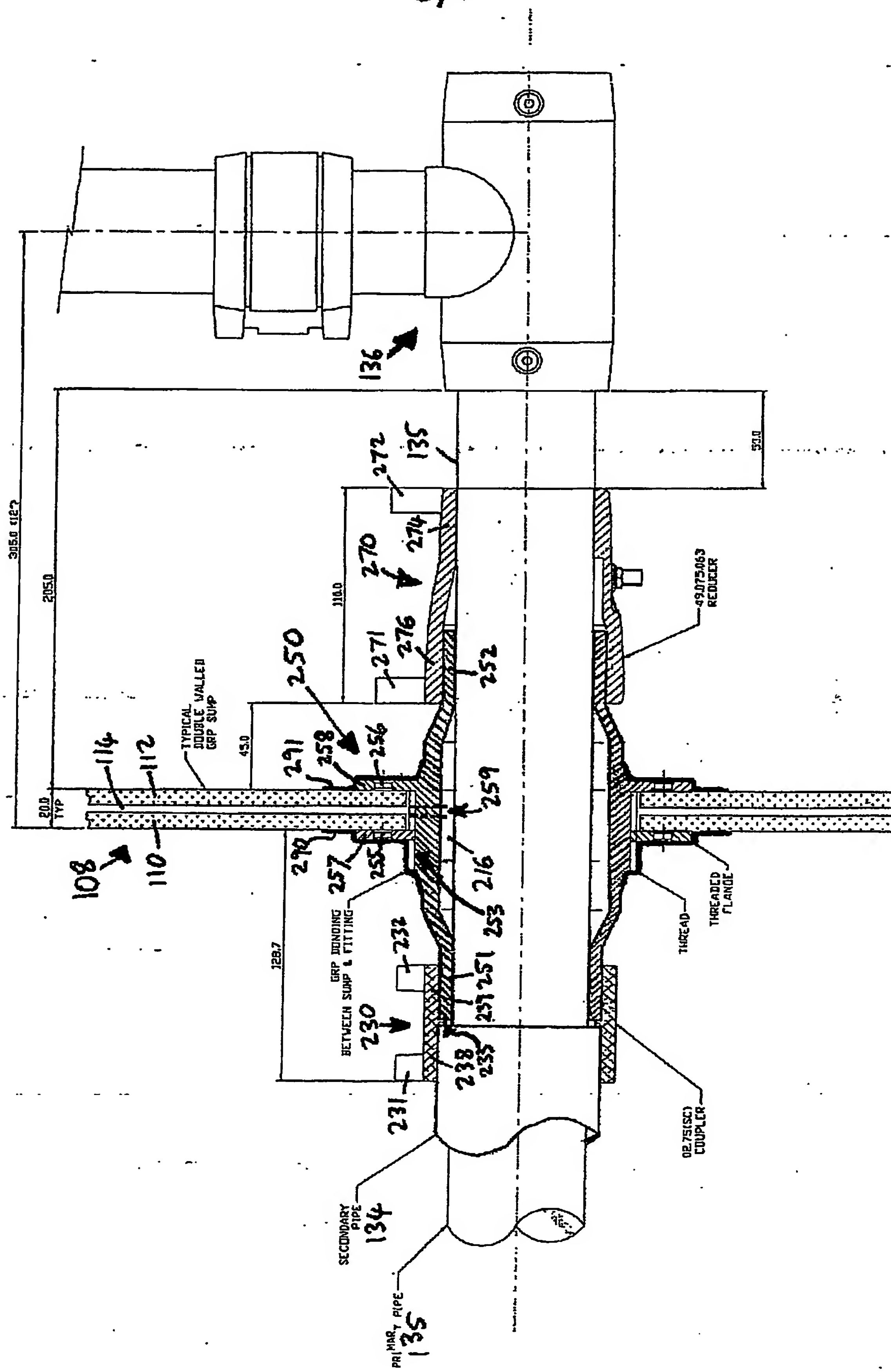

136
135
272
274
270
49.0 75.063 REDUCER
271
276
252
250
291
258
256
259
114
112
TYPICAL DOUBLE WALLED GRP SUMP
108
110
290
257
255
216
253
THREADED FLANGE
THREAD
GRP BONDING BETWEEN SUMP & FITTING
232
251
237
230
238
235
231
COUPLER
SECONDARY PIPE
134
PRIMARY PIPE
135

FIGURE 6

PCT/GB2004/004949